Development of

Carrot Prepackaging

Marketing Research
Report No. 185

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Marketing Research Division
Washington, D.C.

CONTENTS

ACKNOWLEDGMENTS

This report is based on a series of studies undertaken in Agricultural Marketing Service, U. S. Department of Agriculture in cooperation with various segments of the carrot producing and distributing industries. Credit for help in the study is given to Hermes Associates, Santa Clara, Calif., to the Western Growers Association, Los Angles, Calif., and numerous growers, shippers, distributors, and retailers of carrots. Hermes Associates and Western Growers carried out research under contract with the Department on certain phases of prepackaging of carrots. Particular credit is given to the following individuals for their cooperation in this project: R. M. Hermes, Santa Clara, Calif.; C. B. Moore, F. W. Castiglione, George E. Woodhams, and William R. Black, Western Growers Association; and Russell L. Hawes, Fruit and Vegetable Division, Agricultural Marketing Service, USDA.

June 1957

For sale by Superintendent of Documents, Government Printing Office, Washington 25, D. C. Price 25 cents.

SUMMARY

As recently as 1951, a scant 1 percent of the fresh carrots marketed were sold in prepackaged form. By 1956, about 85 percent were prepackaged. The change has resulted in substantial reductions in transportation charges, less spoilage, and better salability of the vegetable.

This rapid shift grew at least in part from 10 years of economic and engineering research conducted by the U. S. Department of Agriculture and the industry. Most of the research has never been published, although much of it was demonstrational in character and has influenced many improvements in practices within the industry. This report describes the studies and findings in some detail, for the guidance of the carrot industry and for other industries that might find similar practices useful.

The objectives of the research were (1) to reduce the cost of marketing carrots, and (2) to improve their salability. The various steps of the research may be summarized as follows:

1. The development of prepackaging of carrots was a gradual process. The Department's initial study was in cooperation with a large eastern chain store organization in the middle 1940's when the tops of ordinary bunched carrots were cut off laboriously at the terminal warehouse and the edible roots were lined up neatly in chipboard trays and overwrapped with cellophane. But consumers seemed reluctant to buy them; the turnover was slow and many carrots spoiled in display cases.

2. After the economic failure of attempts to prepackage carrots at the terminal warehouse, attention was shifted to removing tops in the field and prepackaging at point of production. A study in 3 western packing plants in 1951 and 1952 indicated that the cost of processing and prepackaging topped carrots was $4.19 per 100 pounds, compared with $1.96 for bunched carrots. However, the carrots which were prepackaged in the experiment sold at a premium, and net returns to the shipper were $2.29 per 100 pounds versus $1.73 for bunched carrots--a difference of 30 percent.

3. A methods-engineering study in 2 western packing plants in 1951 and 1952 indicated that prepackaging carrots by the "wheel" or rotating table method was more efficient than packaging them by a one-way conveyor belt line method. A new method was developed to improve the one-way conveyor system. Under the old method, each packer, working independently, performed two separate operations, one after the other. First the packer gathered a double handful of carrots from a moving conveyor belt and placed them in a scoop or tray; then she reached for a film bag, fitted it over the mouth of the scoop, and slid the carrots into the bag. In the new method, teamwork was developed, one packer performing the first operation and another the second. Man-hours required per 100 pounds of carrots prepackaged were reduced 35 percent. The engineering analysis also uncovered a number of shortcomings and defects in the performance of the rotating table method. Improvements were developed, but none of them could be effected without a complete change-over of the plant. Such a change was not considered commercially feasible at the time.

4. Except for an occasional spot-check, neither of the plants in which the engineering analysis was made weighed the carrots which were prepackaged in consumer bags. In one plant, the "1-pound" bags weighed an average of 1.25 pounds each, and in the second plant, "1-1/4-pound" bags averaged 1.42 pounds. Research engineers investigated the possibility of incorporating a scale in the bag-filling operation. A scale with all necessary accessories was developed and tested in 1952. The tests were successful. Many plants have now incorporated scales in their carrot prepackaging operations.

5. Studies to determine the comparative efficiency of alternative methods, machinery, equipment, and production-line arrangements for prepackaging carrots were continued in 5 plants in California, Arizona, and New Mexico, in 1953 and 1954. By employing a combination of the most efficient operational factors observed, it was estimated that packinghouse labor requirements might be reduced by as much as 37 percent. Many plants have now been set up to incorporate some or all of the findings in their operations.

6. A 1954 survey of 26 national chainstore organizations and 26 service wholesalers revealed that 40 percent of them sold only prepackaged carrots and 95 percent sold more than half their carrots in prepackaged consumer units. Most of the chain and wholesaler produce managers favored:

(a) Carrots prepackaged in 1-pound film bags.

(b) Use of a clear film to show the fresh carrots in their natural color, with printing on the bag in blending hues restricted to an area sufficient to permit at least 85 percent visibility.

(c) Carrots of uniform size and packaged to lie all in the same direction.

(d) A pack of 48 consumer bags per master container--preferably a wirebound crate.

7. As late as 1954, consumer reaction to prepackaged carrots was mixed. Prepackaged and bunched carrots were displayed side by side in controlled test sales in 41 stores in 6 cities. In all cities, sales of bunched carrots were 61 percent of total carrot sales. In 5 cities in which conditions were more nearly equal, sales of bunched carrots were 54 percent and sales of prepackaged carrots 46 percent. Extremes in consumer reaction were noted in Los Angeles, where 76 percent of carrot sales were in bunched carrots, and in Boston, where 59 percent of the sales were in prepackaged carrots. Because of greater convenience, lower handling costs, and less spoilage, the store operators themselves overwhelmingly favored selling only prepackaged carrots.

8. The retail store's cost of handling prepackaged carrots was 2 cents per sales dollar as compared to 14 cents for handling bunched carrots, it was indicated by a 1954 study in 2 supermarkets in each of 4 metropolitan areas: New York, Boston, Detroit, and Grand Rapids. Deterioration, waste, and spoilage losses were less than 1 percent for prepackaged carrots and more than 8 percent for bunched carrots.

9. Newly developed master containers for carrots were evaluated in Texas in 1956. It was found that, under suitable conditions, shippers could save from $100 to $145 per carload by using multiwall paper bags or polyethylene bags instead of the conventional crates.

10. The changeover from bunched to prepackaged carrots moved swiftly. Between 1951, when only 1 percent of fresh carrots were prepackaged, and 1956, when 85 percent were prepackaged, Texas forged ahead as the leading winter-season carrot producer. In the same period, total shipments of edible carrot roots from the producing areas of Texas, California, and Arizona increased slightly, although the number of rail carloads and truck carlot equivalents decreased. These divergent trends were due to the fact that, without the carrot tops in the prepackaged units, each car and truck was able to carry more edible roots, with corresponding savings in transportation charges.

DEVELOPMENT OF CARROT PREPACKAGING

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INTRODUCTION

Modern packaging has had a tremendous impact on the production and marketing of fresh carrots. The aim of this report is to review briefly the development of the prepackaging of carrots, particularly as it was affected by marketing research studies undertaken by the U. S. Department of Agriculture.

Department research on the prepackaging of carrots started in 1945. Other public and private organizations also have been active in the field, as have pioneering shippers and distributors experimenting on their own. All Department research was conducted in close cooperation with industry. Knowledge of research findings thus spread rapidly through the industry by observation and word of mouth. New developments followed one another so swiftly that no attempt was made to issue formal reports on every step of the progress.

This report, therefore, rounds out the general picture by outlining the successes and setbacks during the long series of attempts to reduce the cost of marketing and increase the salability of fresh carrots by prepackaging.

Until recently, carrots were normally harvested and marketed in bunches with the tops left on. (fig. 1) Today, most commercially produced fresh carrots are marketed without tops in 1- to 2-pound consumer packages of polyethylene film. The transition from bunched to prepackaged carrots was greatly stimulated by the wide range of research and by the individual pioneering efforts that preceded and accompanied it.

Bunched carrots from the great commercial production areas of California, Arizona, and Texas were shipped for the most part in the Western or Los Angeles crate, generally known as the LA crate (fig. 2). As standardized by California law, this crate was made in three sizes with inside dimensions of 13 x 18 x 21-5/8 inches, 13 x 17-1/2 x 21-5/8 inches or 13-3/4 x 17-1/2 x 21-5/8 inches. The usual pack ranged from 4 to 6 dozen bunches, depending upon the size of carrots; 6 dozen was the most common. The crates usually were packed with an appreciable bulge.[1]

Crushed or "snow" ice was used to keep the carrot roots and tops fresh and in good appearance. Ice was placed in the center of the pack and also on top of the pack under the cover to refrigerate and humidify the carrots. About 25,000 pounds of edible carrots were shipped per carload. After the crates were stacked in the freight car, more crushed ice was usually blown over the load to supply further refrigeration in transit. Therefore, for each carload of carrots shipped, several thousand pounds of ice were required to keep the carrot tops in good condition. This cost money. Not only was ice expensive, but the freight cost to ship the attractive but non-edible carrot tops was also a major item. The possibility of packaging topped carrots was frequently discussed as a means of reducing the cost of marketing carrots.

According to Hauck and Lenox,[2] the average gross weight of a LA crate of carrots was 111 pounds, broken down as follows: Tare weight (that is, container, cover, liner,

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[1] Carey, L. C., Containers in Common Use for Fresh Fruits and Vegetables, F. B. No. 2013, U. S. Dept. Agr. 1950.
[2] Hauck, C. W., and Lenox, W. L., Tare Weight and Waste in Marketing Fresh Fruits and Vegetables, Farm and Home Research, March-April 1947, Vol. 32, No. 245, Ohio Agr. Exp. Sta., Wooster, Ohio.

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Figure 1.--A field of western carrots pictured during the harvest season several years ago. After being pulled from the ground, the carrots first were gathered into 1-pound bunches. Then 6 of these small bunches were tied into a master bunch for packing and shipment. In this photo of a large commercial operation, rows of newly harvested carrots in master bunches are ready for trucking to the packing plant. Carrots to be prepackaged are not bunched, but are topped immediately after pulling by the harvest crew.

ice, etc.), 19-1/2 pounds; trimmings (that is, carrot tops and inedible portions of the carrots), 29-1/2 pounds, and salable carrots, 61 pounds.

In addition to the expense of transporting and refrigerating the tops of fresh carrots, there was also the cost of deterioration and spoilage losses while they were being displayed for sale in retail stores.

According to one study,[3] these retail losses amounted to 3.8 percent of the value of the carrots handled in retail stores. In another study,[4] loss of carrots at the retail store level was 4.4 percent of the weight of the carrots received. The bunched carrots wilted on display in the retail stores--both the tops and the edible roots. In addition to causing deterioration and spoilage losses, wilting also made the carrots unattractive for sale. Then, too, many small stores did not handle fresh carrots because their volume of business did not permit a sufficiently rapid turnover to enable them to handle the conventional 6-dozen LA crate. In other words, 6 dozen bunches of carrots could not be sold fast enough to prevent extreme spoilage losses.

Many marketing researchers believed that the development of some method of packaging carrots in consumer units would reduce the cost of handling and the spoilage losses, and maintain the attractive appearance of the carrots, which in turn would promote sales. Therefore, the main objectives of this whole series of studies were to (1) decrease the cost of marketing, and (2) increase the salability of fresh carrots.

[3] Stokes, Donald R., Waste and Spoilage Losses in Merchandising Fresh Fruits and Vegetables in Bulk in Self-Service Food Stores, U. S. Dept. Agr., August 1947.

[4] Hauck, Charles W., and Lenox, W. H., Normal Food Waste--Is It Irreducible, Ohio Agr. Exp. Sta. Bul., Vol. 31 No. 243, Nov.-Dec. 1946.

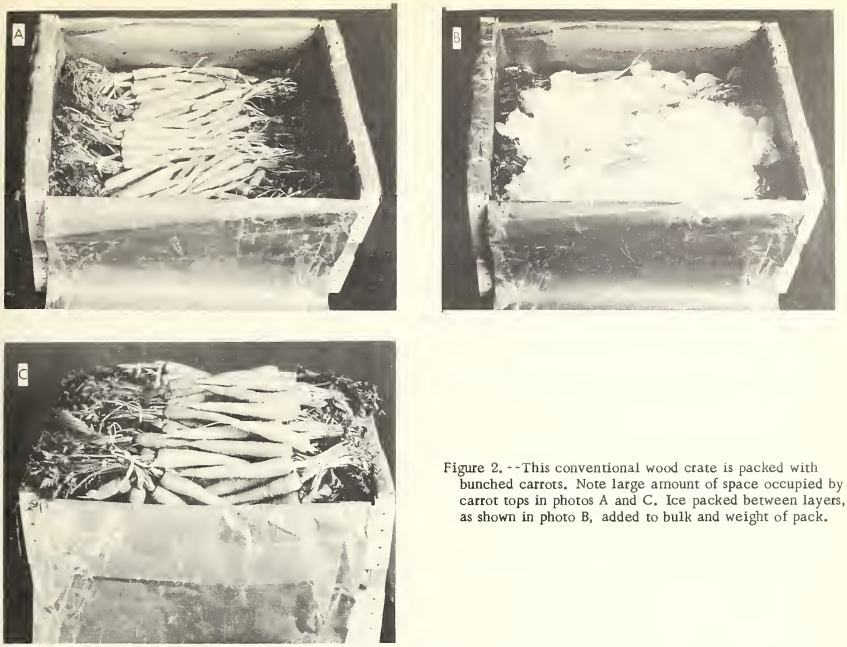

Figure 2. --This conventional wood crate is packed with bunched carrots. Note large amount of space occupied by carrot tops in photos A and C. Ice packed between layers, as shown in photo B, added to bulk and weight of pack.

TOPPING AND PACKAGING CARROTS AT WAREHOUSE LEVEL, 1945-48

In the mid-1940's, several of the larger food chains began experimenting commercially with prepackaging at the warehouse level. The Department of Agriculture cooperated with a large grocery chain beginning in 1945 on a project to determine the economic feasibility of retailing fresh fruits and vegetables which were prepackaged at the warehouse for distribution to their own self-service stores. Fresh carrots were one of the major commodities prepackaged and test-sold.[5]

In this experiment, carrots were received in conventional form, that is, bunched in LA crates. The inedible carrot tops were cut off and the tips of the carrot roots were trimmed to even lengths, making the carrots more attractive and completely edible. They were then packaged in chipboard trays and overwrapped with cellophane. The packaging materials, including the tray and cellophane, cost about 2 cents per container, and the labor to trim and pack the carrots cost about 2 cents. Although this made an attractive package, the carrots did not sell well in the retail stores. This was mainly becuase the public associated topped carrots with "stored" carrots and lacked confidence that the prepackaged topped carrots were really fresh carrots.

To overcome this resistance, sprigs of carrot tops were inserted in the package to inform consumers that they were fresh carrots. In spite of this, the sales of prepackaged

[5] Stokes, Donald R., Retailing Prepackaged Fresh Produce by Self-Service Food Stores, Marketing and Transportation Situation, BAE, USDA, April-May 1948.

The studies on which this report was based were made in cooperation with the American Stores Company.

carrots were so low and the turnover so slow that they deteriorated in the refrigerator cases while on display in retail stores. For this reason, the deterioration and spoilage losses of the prepackaged carrots in this experiment were found to average 6.2 percent, as compared to 4 percent in comparable stores where carrots were displayed in bunches.[6]

Since the prepackaged carrots did not sell well, bunched carrots were also put on display in the same stores. Sales of bunched carrots were approximately $30 per week as compared to $9 per week for prepackaged carrots (10 store weeks, June-November 1946). During the entire year 1946, the consumer acceptance was greater for the bunched fresh carrots than for the prepackaged fresh carrots. However, as more and more consumers tried the prepackaged carrots, the relationship changed so that by 1948 the packaged carrots outsold the bunched carrots in the stores in which the study was being made.

PACKAGING TOPPED CARROTS VERSUS BUNCHING CARROTS AT POINT OF PRODUCTION, 1951-52

During the progress of the various experiments by the grocery chains, in prepackaging carrots at the warehouse level, many important carrot shippers, were experimenting with the prepackaging of carrots at the production level. Early attempts to package carrots in cellophane bags were comparatively unsuccessful. These attempts were followed by prepackaging carrots in rubber hydrochloride film bags. This film was gradually replaced by polyethylene film.

Some carrot producers in Texas also experimented commercially with prepackaged carrots during the 1940's. However, there was general lack of enthusiasm on the part of the consuming public for prepackaged carrots at that time. Nevertheless, another project was initiated in 1951 to appraise the economic feasibility of prepackaging carrots at the shipping point.

Cost and Net Returns from Packaging Carrots in Different Types of Containers[7]

A study of the comparative cost of prepackaging carrots, in comparison with packing them in bunches in LA crates or packing topped carrots in bulk in mesh bags or wire-bound crates, was made in four carrot-packing plants at the points of production in California, Arizona, and New Mexico in 1951 and 1952. The cost and net returns of 3 shippers for packing carrots in these alternative containers are shown in table 1.

It cost more than twice as much to process and prepackage carrots as it did to prepare them for market in bunches. Processing topped carrots for bulk shipment in crates or bags cost still less. However, the carrots, which were prepackaged primarily on an experimental basis, sold at an unexpectedly high premium in selected markets, and actual net returns to the shipper were higher for prepackaged carrots than for either bunched carrots or topped carrots marketed in bulk.

Average net returns from prepackaged carrots were more than 30 percent greater than from bunched carrots. Three plants, in which a complete cost-price analysis was made, had an average net return of $2.29 per 100 pounds from prepackaged carrots, compared with an average net return of $1.73 per 100 pounds from bunched carrots. Net returns from snap-top carrots in 50-pound mesh bags averaged $1.27 and net returns from snap-top carrots marketed in 50-pound crates averaged $1.19. (All carrots from which tops have been removed are topped carrots. The tops may be either cut off or snapped off manually. Thus, topped carrots often are referred to as clip-top or snap-top carrots.)

[6] Ibid.

[7] This study on costs and returns from packaging carrots in different types of containers in 4 plants, and methods and engineering studies in 2 plants as reported in the 2 following sections, were conducted by Hermes Associates for Santa Clara, Calif., under a contract with the U. S. Department of Agriculture.

Table 1.--Comparative average net sales price, production costs, and net returns, per equivalent 100 pounds of carrot roots, for marketing western carrots in alternative containers, 3 plants, 1951-52[1]

Item	Prepackaged snap-top carrots in film bags				Snap-top carrots in 50-pound mesh sacks			
	Plant A	Plant B	Plant C	Average	Plant A	Plant B	Plant C	Average
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Net sales price.....	8.33	8.22	9.09	8.55	4.75	4.12	5.00	4.62
Less:								
Field production costs	1.42	1.13	1.66	1.40	1.42	1.21	1.66	1.43
Harvesting costs.....	.66	.61	.74	.67	.66	.66	.74	.67
Processing and packing costs.....	3.77	3.96	4.85	4.19	1.03	1.37	1.36	1.25
Total costs.....	5.85	5.70	7.25	6.26	3.11	3.24	3.76	3.35
Net return.....	2.48	2.52	1.84	2.29	1.64	.88	1.24	1.27

Item	Snap-top carrots in 50-pound crates				Bunch-top carrots in 72-bunch LA crates			
	Plant A	Plant B	Plant C	Average	Plant A	Plant B	Plant C	Average
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Net sales price.....	4.75	5.76	5.00	5.17	5.77	6.12	6.74	6.21
Less:								
Field production costs	1.42	1.21	1.66	1.43	1.60	1.21	1.66	1.49
Harvesting costs.....	.66	.66	.74	.69	1.08	.90	1.11	1.03
Processing and packing costs.....	1.45	2.37	1.75	1.86	1.83	2.14	1.92	1.96
Total costs.....	3.53	4.24	4.15	3.98	4.51	4.25	4.69	4.48
Net return.....	1.22	1.52	.85	1.19	1.26	1.87	2.05	1.73

[1] Sales prices, costs, and net returns data were obtained from 3 plants in 3 important carrot-producing regions during typical 4-week periods of their operations. One plant was located in Salinas, Calif., one in Grants, N. Mex., and one in Phoenix, Ariz.

An attempt to determine comparative net returns was made at a fourth plant also, but its prepackaged carrots and bunched carrots were sold during different periods. In one period, the general price level for carrots was high and in the other period the price level was low. Net returns, therefore, could not be compared validly. However, other data for this plant are used later in this report.

Although processing and packing costs were higher for prepackaged snap-top carrots than for bunched carrots and snap-top carrots marketed in 50-pound sacks and crates, the premium they brought was sufficient to outweigh the difference in costs. Also weighting the balance against the bunched carrots were higher harvesting costs for the bunched carrots. Tying the newly dug carrots first, into single bunches weighing approximately 1 pound each, and then tying 6 of these bunches into master bunches, added about 35 cents per 100 pounds to the harvesting cost.

At 3 plants the net sales price for the prepackaged carrots averaged $8.55 per 100 pounds, for bunched carrots $6.21, for sacked snap-top carrots $4.62, and for crated snap-top carrots $5.17. Processing and packing costs for prepackaged carrots in the 3 plants averaged $4.19 per 100 pounds, for bunched carrots $1.96, for snap-top carrots in crates $1.86, and for snap-top carrots in sacks $1.25. In a fourth plant, processing

and packing costs were $4.04 per 100 pounds for prepackaged carrots, $2.18 for bunched carrots, $1.67 for snap-top carrots in 50-pound crates, and $1.21 for snap-top carrots in 50-pound mesh bags.

Differences in production costs were influenced both by plant efficiency and by wage levels. It was found that a high degree of plant efficiency could outbalance a moderate difference in wage levels.

To illustrate, Plant A was considerably more efficient than Plant B in its processing and packing operation. The wage level of Plant A was approximately $1.22 per hour while the level at Plant B was about $.80 per hour. Yet the cost of processing and packaging prepackaged carrots was only $3.77 per 100 pounds at Plant A compared with $3.96 per 100 pounds at Plant B.

Comparative efficiency of different methods of packaging carrots in 2 plants

In two plants in which engineering methods studies were made, a striking difference was observed in the method of performing the prepackaging operation. In the first plant, 7 girls selected and gathered up, from a trough rimming a rotating table, approximately 1 pound of carrots which they placed in a swivel tray or scoop attached to the same table (fig. 3). As the scoops moved around with the table, 4 other girls fitted polyethylene bags over the mouths of the trays, tilted the trays, and dumped the carrots into the fitted bags. The open bags then were placed on conveyor belts which carried them to 2 girls who ran the bags through heat-sealing machines for closure.

In the second plant, 16 swivel trays lined either side of a one-way conveyor belt which brought the carrots to the packaging line. One girl stood behind each tray. As the carrots passed on the belt, each girl reached over her tray, selected approximately a pound of carrots in both hands, placed the carrots in her tray, reached for a film bag, fitted the bag over the mouth of the tray, tilted the tray to slide the carrots into the bag, and tossed the full bag over her shoulder to a table where 4 girls closed the bags with wire tags.

The time required in the first plant for 2 groups of girls to perform the tray filling and the bag filling in 2 steps was .238 man-hour per 100 pounds of carrots packaged. The time required in the second plant for a single group of girls to perform the combined operation of tray and bag filling in a single step was .581 man-hour per 100 pounds of carrots packaged.

In a move to cut the labor expenditure, the method of operation in the second plant was revised; a second conveyor was installed directly above the main conveyor which carried the carrots through the packaging line, and the plant layout was changed by moving the tables for the bag-closing operation from behind the packagers to the end of the new conveyor. With the new procedure, teamwork was introduced; one group of 8 operators selected the carrots from the main belt and filled the trays; a second group of 8 operators filled the bags from the trays. Then, instead of tossing the full bags over their shoulders to the closing tables or turning to place the bags on the tables, the girls in the second group placed the full bags on the new conveyor which carried them to the newly placed closing table.

Direct labor for the new operation was .376 man-hours per 100 pounds of carrots packaged. The improvement from the old rate of .581 man-hours per 100 pounds was 35 percent. However, this could not be attributed entirely to the effectiveness of the new method of operation. Much of it undoubtedly was due to the increased efficiency of the packers as a result of additional training and experience between the early season and the late season. In terms of money savings, the reduction in direct labor requirements cut the packaging labor cost .132 cent per bag on the basis of the performance observed.

The engineering analysis also uncovered a number of shortcomings and defects in the performance of the rotating table method. Improved methods were developed for trial

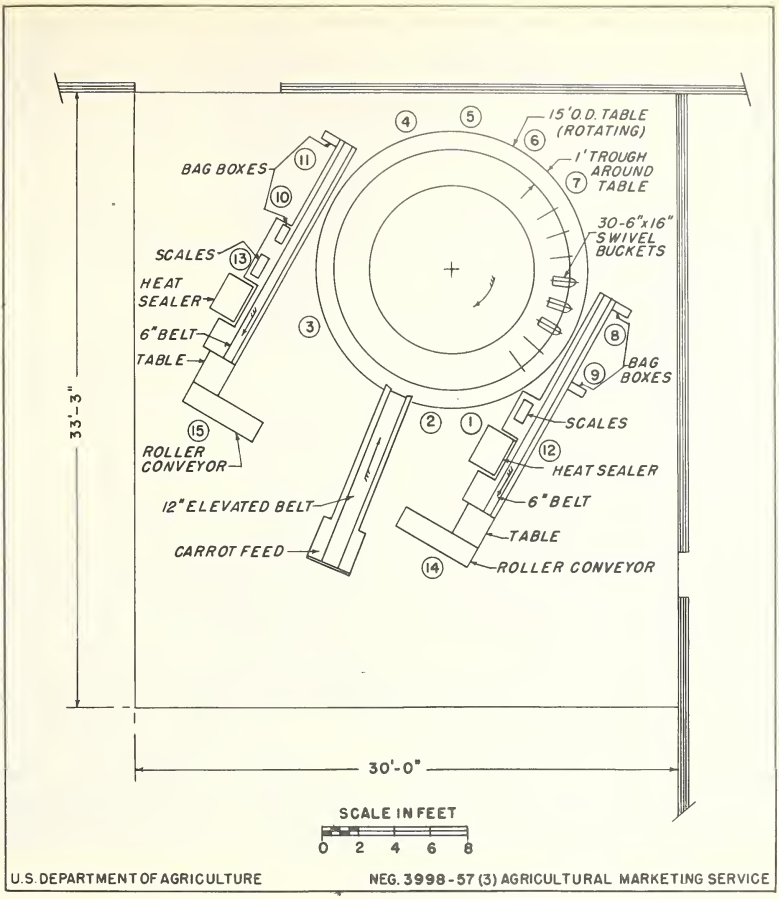

Figure 3.--This is the rotating table used early in the development of prepackaging carrots. The carrots--all topped, washed, sized, and sorted--entered the packaging setup on a conveyor belt at point marked "carrot feed." The carrots spilled into a trough rimming the table, which rotated clockwise. Operators at positions 1 through 7 picked carrots from trough and placed them in buckets or scoops. Operators at positions 8 through 11 dumped carrots from scoops into 1-pound film bags. Operators 12 and 13 sealed the bags and operators 14 and 15 packed them into shipping containers.

but none of them could be introduced without an almost complete changeover of the plant. Such a change was not considered commercially feasible.

Neither plant portioned out its carrots by weight before bagging them. The "proper" amount to put in a bag was selected by eye and by feel by the girl who picked up the carrots as they moved through the packaging line and placed them in the trays. Occasionally a worker farther along the line, usually a bag closer, weighed a bag that seemed light. If it was underweight, she added a carrot or two.

This check-weighing method resulted in comparatively heavy overpacking. The first plant fed 748,450 pounds of carrots through its packaging line in a 6-week period and shipped out 627,408 "1-pound" bags. Since there was no appreciable waste, shrinkage or disappearance on the packaging line, it was evident that the "1-pound" bags shipped out actually contained, on the average, nearly 1.25 pounds of carrots. This average bag weight was confirmed by sample checks on accurate scales. The difference between the pounds of carrots packaged and the number of "1-pound" bags for which the packer was paid 157,042. At levels prevailing at the time, 157,042 pounds of carrots would be valued at $4,201.

The second plant did not weigh its carrots before they entered the packaging line and therefore it was impossible to compare the number of pounds processed with the number of bags sold. However, the weights of many hundreds of bags were checked. It was found that the average weight per bag was 1.42 pounds, as compared with a selling weight of 1.25 pounds.

Development of Improved Method of Prepackaging Carrots

No attempt was made in either of the two plants described to control the weight of individual bags except insofar as they occasionally were check-weighed while being sealed. Therefore, it was deemed worthwhile to investigate the possibility of incorporating a scale in theloading operation. A test weighing stand was designed, built, and tested (fig. 4).

One operator loaded the scoop from the main conveyor belt with carrots and weighed them. A second operator opened the bags, slipped them over the scoop, dumped the carrots into the bags, and dropped the bags into a chute. A bracket supported a 1/4-inch pin which in turn supported the scoop except when the load in the scoop was near the required weight. As balance was reached, the scoop came away from the supporting pin and the weight of the scoop was then carried on the pan of the scale. Thus, the scale was protected from sudden loads and shocks. There was a sheet metal chute with an opening directly under the scoop. Bagged carrots were dropped directly into this chute for transfer by a second conveyor belt to the bag closing station.

The process charts for the two operators are shown in figures 5 and 6. The elements were as follows: For the operator who is engaged in filling the scoop--both hands move empty to the conveyor belt, where they search for carrots, and each hand individually grasps a handful of carrots. The hands are then moved loaded to pre-position the carrots over the scoop.

The carrots are then dropped into the scoop. The scale used was an exceedingly rapid over-and-under scale and came to its rest position in something less than a half-second. The operator deliberates. If the load is under the 1-pound mark, she adds another carrot. If it is over the 1-pound, 2-ounce mark, she removes a carrot and then begins her cycle over again.

The sequence of operations for the operator who is dumping the buckets was as follows: When the carrots have been dumped from the scoop into the bag, she uses her right hand to release the bag and return the scoop to its rest position. While this is going on, the left hand moves empty to the bag box, where it grasps a bag and removes it from the box with a sliding motion. There is attached to the lip of the box a piece of fabric so designed as to retard the progress of the lower side of the bag, thus opening the bag as the operator slides it out of the box. The hand with the bag moves to the position immediately in front of the scoop, where the two hands now are used to complete the opening of the bag. As soon as the operator who is loading the scoop starts the operation of moving both hands empty, leaving the scoop free, the operator who is dumping the scoop slides the bag over the front of the scoop and, with one motion, upends the scoop and starts the carrots into the bag. The right hand then is used to delay the disassembly of the bag and scoop until the carrots are seated as outlined at the beginning of the analysis of this operation. The cycle is then continued.

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Figure 4. --This integrated scoop and scale unit was experimentally fitted into the production line, of an early prepackager. The operator at right selected approximately 1 pound of carrots from the conveyor belt at her left and placed them in the scoop. If the scale showed the weight to be low, she added a carrot or so. If weight was too high, she removed one or more. Operator shown at left in side view slid the carrots from the scoop into a film bag which then was dropped into the metal chute to be conveyed to bag-closing station. Operator at left is fitting bag over mouth of full scoop. Operator at right is selecting another handful of carrots from conveyor belt.

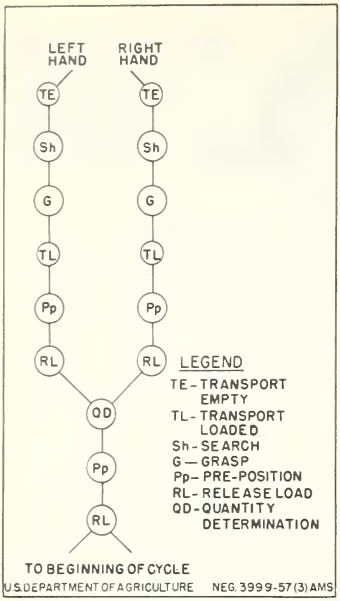

Figure 5. --This process chart portrays the moves involved in filling scoop with carrots and weighing them. Abbreviations are explained in legend.

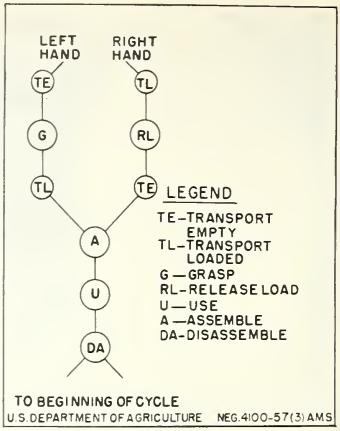

Figure 6. --These are the movements of the operator who transferred the carrots from the scoop to the film bag. The chart starts at top with left hand moving empty towards bag box and right hand moving loaded as it pushes scoop to horizontal starting position.

The standard times for this sequence of operations were computed. To obtain time, each motion of an average experienced operator in performing an operation is analyzed and timed. To this time there is added an allowance for fatigue and personal needs. The result is a standard time for the motion or element. The sum of individual standard times for motions or elements thus becomes the standard time for the entire work operation. Standard times for the bucket-filling elements were as follows:

Element		Time in minutes
Secure carrots:	Transport empty - 0.007	
	Search and grasp - 0.024	
		0.031
Place on scale:	Transport loaded - 0.007	
	Place and release - 0.019	
		0.026
Deciding factor (to read scale and add or remove carrot)		0.050
	Total time of cycle	0.107

Standard times for scoop-dumping operation elements were as follows:

	Element		Time in minutes
Secure bag:	Transport empty	- 0.002	
	Search and grasp	- 0.011	
	Other hand completing move	- 0.005	
			0.018
Position bag:	Transport loaded	- 0.002	
	Position bag	- 0.019	
			0.021
Dump and return scoop[1]			0.004
	Total time of cycle		0.043

Note: Total allowed time for cycle is time for loading, since dumper is paced by loader's time.

[1] This time could have been halved by using a spring return on scoop. The spring is now installed in most packing plants.

It will be noted that the time for dumping the scoop is less than one-half the time taken as standard for filling it, and the possibility arose of using 1 girl for emptying 2 scoops. The inclusion of the scales in the sequence, however, appeared to render this possibility unlikely for the following reasons:

(a) Because of the physical size of the scales, it was impossible to arrange the scoop-filling stations along the edge of a straight conveyor and close enough together so that one girl could dump two scoops conveniently. Were it necessary for her to stretch or to undertake any bodily motion to reach the scoops, the standard time for the scoop-dumping operation would be increased so much that it would be greater than one-half the standard time for the scoop-loading operation.

(b) The standard time for the scoop-loading operation included an allowance of 0.050 minute for the deciding factor. Experience with the system has shown that this allowance was probably too generous for an experienced operator. Since the allowance constituted almost half of the standard time, it seemed likely that experience would require that the standard time for the scoop-filling operation be reduced.

(c) As just outlined, the standard time for the scoop-loading operation appeared to be generous; on the other hand, experience had revealed that the standard time for the scoop-dumping operation was very nearly an ideal time and could be approximately maintained only under ideal conditions. One serious obstacle to attaining approximately this standard time was in the imperfections in the bags used.

In order to test the automatic scale experimentally before recommending its use to the cooperating packers, it was operated in the contractor's shops. In this test, college students were used as operators. Two crates of 48 one-pound bags were procured and were opened for this test. The total weight of carrots in the 96 bags was 123.4 pounds. These carrots were fed into the test system. They were gathered by one operator and placed in the scoop. A second operator then dumped the carrots from the scoop into the bags, seated them, and released the bags. A third and fourth operator then check-weighed the bags and dumped the carrots from them back in the system again. In this way, several consecutive runs of approximately one-half hour each were carried out.

The first several half hours of operation were devoted to getting acquainted with the equipment, rearranging it into what seemed the best configuration, and acquiring some skill in its operation. During the last two half-hour runs, a gross performance check was made by observing the number of bags packed in various 5-minute intervals.

The average rate of packing for the observed runs was 8.08 bags per minute, although one run was considerably higher, 10-1/2 bags per minute. Toward the end of the last half-hour run, the recirculating of the packaged carrots was discontinued, and all the carrots were put into the bags and left there. The operation concluded with 119 bags of carrots, whereas it had started with 96.

The average rate of 8.08 bags per minute corresponded to a time of 0.124 minute per bag. This figure in conjunction with the standard time of 0.107 minute per bag yielded a performance factor for this test of 86.3 percent. (Performance factor is standard time divided by actual time and multiplied by 100 to express it as a percentage.) It will be noted that the maximum rate of 54 bags in 5 minutes or 10.8 bags a minute yielded a time per bag of 0.093 minute per bag, which in turn gave a performance factor of 115 percent. It was this fact which led to the belief that the deciding factor 0.050 which had been allowed in computing standard time was too high.

In view of the results just cited, it was believed that women operators who were adequately trained and who had had some experience in the operation of this equipment could probably attain and maintain a performance of approximately .080 minute per bag, a figure found by reducing the deciding factor in the standard time computations to half of its original value. It was not believed that this performance could be reached by inferior labor or even by good labor in the first week or so of operation.

In plant A, for example, the output for the first week amounted to 37 crates per hour, which gave a performance factor of 46.6 percent. However, after a few weeks of operation, the output rose to 77 crates per hour, which gave a performance factor of 97 percent. There was no reason to doubt that a corresponding performance factor could be achieved with the proposed system.

The weighing and bagging machine was installed in plant B and was operated by the ordinary unskilled help which was employed in that plant, the operators being a girl who normally filled scoops and a girl who normally dumped them (fig. 5). After the operators had spent about an hour becoming acquainted with it, a series of observations for 3-minute intervals was made. The number of bags packed in each of these 3-minute intervals is recorded below as observations 1 through 10:

Observation No.	1	2	3	4	5	6	7	8	9	10
No. of bags	12	13	12	12	14	15	12	14	14	11

$$\text{Average} = \frac{129}{30} = 4.30 \text{ bags/min.} = 0.233 \text{ min./bag}$$

$$\text{Performance factor} = \frac{0.107}{0.233} \times 100 = 45.9 \text{ percent}$$

The average of the 10 observations was 4.30 bags per minute, which corresponded to a performance factor of 45.9 percent. A subsequent run was made wherein the designer of the equipment stood next to the girl who was loading the bucket and told her when to add another carrot or when not to. This was done in an effort to evaluate the effect of the decision factor in the operation. In a series of 10 observations wherein the number of bags in a 3-minute period was recorded, the average rate of bagging carrots was appreciably increased. The results are listed below as observations 11 through 20:

Observation No.	11	12	13	14	15	16	17	18	19	20
No. of bags	20	19	21	21	20	21	21	20	20	20

$$\text{Average} = \frac{203}{30} = 6.76 \text{ bags/min.} = 0.148 \text{ min./bag}$$

$$\text{Performance factor} = \frac{0.107}{0.148} \times 100 = 72.3 \text{ percent}$$

In this case, the average number of bags per minute was 6.76, which correspond to a performance factor of 72.3 percent. It should be noted that the rate for weighing in this case of 6.76 bags per minute was higher than that achieved by the girls at either station 3 or 7, when they were packing the bags without weighing them. It thus appeared that the presence of the designer of this system influenced not only the decision factor but also the overall effort which the girls put into the carrot-packing procedure.

The method described for weighing and packaging carrots in film bags is used, with some variations, in many plants in 1957. However, many others still do not weight the contents of each bag but deliberately overpack them, according to labeled net weights, only occasionally check-weighing them. Some plant managers do this because they find the extra labor cost to weigh each bag accurately is not justified in view of the cost of growing the carrots and in relation to the sales price that "full" bags of carrots command on the market.

METHODS OF PREPACKAGING CARROTS AT POINT OF ORIGIN, 1953-54

The rapid transition from the conventional method of marketing bunched carrots to marketing carrots in film bags stimulated a demand for research to determine the comparative suitability of alternative methods, machinery, equipment, and production-line arrangements employed in the new industry. Much of the machinery was homemade, converted from some other use, or was new and unproved. For the most part, too the plants themselves had been converted from some other use.

To attain the research objectives listed in the foregoing paragraph, the Department entered into a contract with the Western Growers Association[8] for a survey of carrot prepackaging plants and analysis of the production process employed in each. Five plants were selected for the study. Three were in California, one was in Arizona, and one in New Mexico. Packaging of more than 100,000 pounds of carrots was observed in each plant.

A summary showing the hours of plant operation observed, the average number of employees in each plant, the total number of man-hours of labor expended on the packing operation, the volume of carrots packaged, and the man-hours required per 100 pounds of carrots packaged is contained in table 2.

Table 2.--Summary of observations of operations in 5 western carrot-packing plants, 1953-54

Item	Plant				
	A	B	C	D	E
Hours of plant operation observed.....	27.95	21.92	10.53	7.83	15.08
Average number of workers on job.....	31	67	112	81	92
Total man hours of labor in observation period.....	878.28	1458.00	1180.40	632.73	1387.67
Pounds of carrots packaged.....	139,529	133,027	174,941	127,086	122,914
Man hours per 100 lbs. of carrots packaged.....	0.629	1.096	0.675	0.497	1.126

[8] The Western Growers Association is a nonprofit organization of vegetable growers and shippers in California, Arizona, and New Mexico. Many of the data developed in this section were obtained by William Black and George Woodhams of the Western Growers Association, under the supervision of Frank W. Castiglione, executive vice president of the Association. Surveys on trade acceptance and salability of prepackaged carrots, reported in the two following sections, also were conducted under contract by the Association.

General Method of Operation

Although the production process varied in detail from plant to plant, the main operations followed a general pattern:

1. Newly harvested carrots hauled in from the fields were dumped and washed. Conveyor belts picked up the carrots in the washers and carried them through the production line.

2. The carrots were sorted and sized. Culls, "jumbos," and "peewees" were removed from the flow of carrots before they reached the packaging line. Culls were removed from the plant in bulk. "Jumbos" and "peewees" were sacked. Occasionally, when there was a demand for them, "peewees" were packaged.

3. Carrots in the medium size range were picked by hand from the moving conveyor belt, placed into trays and slipped from the trays into film bags. The bags occasionally were check-weighed, and then closed.

4. Shipping containers were assembled and delivered to the packing line.

5. The film bags were packed into the shipping containers.

6. The containers were closed, stamped, moved to the shipping platform, and loaded into freight cars or trucks.

7. In addition to the six regular operations, the researchers listed a classification called "supervision and miscellaneous." Under this was included all labor which could be assigned to no particular operation. The time was charged to the production process as a whole.

The average amount of time required to process 100 pounds of carrots and the proportionate amount of time consumed in each operation are listed in table 3. The prepackaging operation itself--tray filling, bag filling, and bag closing--absorbed an average of 63 percent of all the man-hours expended.

Table 3.--Average man-hours of direct labor and percentage of total labor required for each operation, per 100 pounds of carrots packaged, 5 western plants, 1953-54

Operation	Man-hours	Percent of total
1. Dumping and washing	0.018	2.2
2. Sizing, sorting, and sacking	.144	18.0
3. Packaging and associated operations	.507	63.1
4. Container assembly and delivery to line	.030	3.7
5. Filling shipping containers	.034	4.2
6. Closing, transferring, and loading shipping containers	.042	5.2
7. Supervision and miscellaneous	.028	3.6
Total, all operations	0.803	100

Comparative Efficiency of Different Methods of Operation

The comparative efficiency of different methods of performing the various operations, as observed in the 5 plants, is shown in the following sections of the report.

Dumping:

Method 1: Manually from sacks.--Carrots were dumped manually from 50-pound sacks. At plant A, one man shook out carrots into a tumbler washer unit. At plant C, which had a faster production line, 3 men poured the carrots evenly onto a moving conveyor belt which carried them to the washer (fig. 7). At these 2 plants, dumping from sacks required an average of .019 man-hour of direct labor per 100 pounds of carrots packaged (table 4).

Table 4.--Man-hours of direct labor required to dump and wash carrots, per 100 pounds of carrots packaged, 5 western plants, 1953-54

Operation and method	Plant					Average
	A	B	C	D	E	
Dumping:						
1. Manually from sacks...	.020	--	.018	--	--	.019
2. From trailers.....	--	--	--	.006	.024	.015
3. From dump trucks.....	--	[1] 0	--	--	--	000
All methods.....						.014
Washing control:						
1. By dumper and sorter..	[2] 0	--	--	--	--	0
2. By plant operator.....	--	--	[3] 0	--	[3] 0	0
3. By washer operator....	--	.016	--	.006	--	.011
All methods.....						.004
Total dumping and washing	.020	.016	.018	.012	.024	.018

[1] Less than .001, actually approximately .0003.
[2] Time for occasional attention charged to dumping and to sorting.
[3] Time charged to general plant operations.

Method 2: From trailers.--At two other plants, the carrots were delivered in bulk in 4-wheel harvesting trailers. A hoist, attached to one side, tilted the trailer and spilled out the carrots. At plant D, where carrots went directly into the washing unit, 1 man attached the hoist and performed the dumping operation. At plant E, where the carrots went into a pit, 2 men dumped the trailer and pushed the carrots onto conveyor belts which carried them to the washer. At these 2 plants, dumping from trailers required an average of .015 man-hour of direct labor per 100 pounds of carrots packaged.

Method 3: From dump trucks.--Carrots were delivered in bulk in hydraulic-lift dump trucks which backed into place and cascaded the carrots into the washing unit (fig. 8). No plant labor was required for this operation at plant B. The driver's time in terms of 100 pounds packaged was less than .001 man-hour and was below the minimum time entered in the tables of this report.

Although the hydraulic lift truck was a piece of specialized equipment, not nearly as common in the harvesting fields as the 4-wheel flatbed trailer, it was by far the most efficient for this operation. Unless dump trucks could be leased for the carrot harvesting season as these were, or unless they could be put to good use throughout the year, it might be more economical to use trailers, which are cheaper and are designed to handle many harvested commodities other than carrots.

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Figure 7. --Dumping carrots by hand from bags was found to be the slowest way to unload carrots at the packing plant.

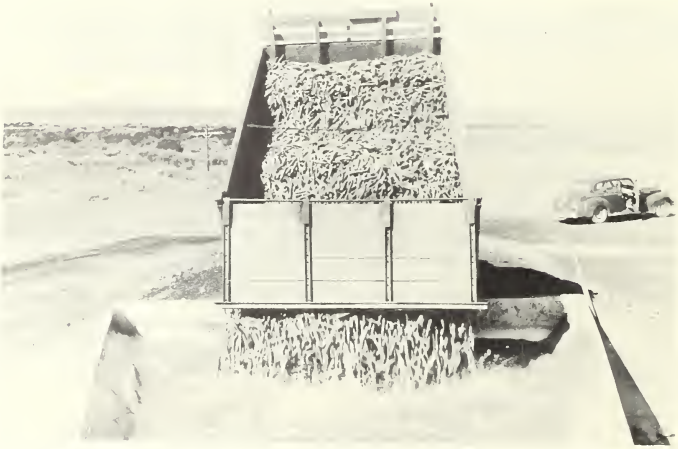

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Figure 8. --Cascading carrots from a dump truck directly into a washing tank was the fastest of the ways observed to unload carrots.

Washing:

Method 1. --Washing machine controls were operated when necessary by the dumper or by the first sorter at plant A. No direct labor was charged to the washing operation.

Method 2. --The controls were regulated at the main switch panel by the plant machinery operator at plants C and E. No direct labor was charged.

Method 3. --The controls were regulated by a full-time washing machine operator at plants B and D. At these 2 plants, the full-time operator represented an average of .011 man-hour of direct labor per 100 pounds of carrots packaged.

Either the dumper-sorter control or the plant machinery operator control might be considered the most efficient method of regulating the washing operation.

SIZING, SORTING AND SACKING

Sizing and Sorting:

Method 1: Manual sizing and sorting. --Carrots were sized and sorted manually in plants A, B, and C. Workers hand-picked "jumbos," "peewees," and culls from a moving conveyor belt, leaving good-quality carrots of medium size to pass on through the packaging line. The direct labor required for this operation per 100 pounds of carrots packaged ranged from .101 to .179 and averaged .128 man-hour (table 5).

Table 5.--Man-hours of direct labor required to size, sort, and sack, per 100 pounds of carrots packaged, 5 western plants, 1953-54

Operation and method	Plant					Average
	A	B	C	D	E	
Sizing and sorting:						
1. Manual sizing, manual sorting	.101	.179	.105	--	--	.128
2. Manual-mechanical sizing, manual sorting	--	--	--	--	.159	.159
3. Mechanical sizing, manual sorting	--	--	--	.062	--	.062
Sacking:						
1. Manual	.010	.015	.039	.012	.037	.023
Total sizing, sorting, and sacking	.111	.194	.143	.074	.196	.144

Method 2: Manual-mechanical sizing, manual sorting. --A mechanical sizer separated out only "jumbos" at plant E. "Peewees" were sized out manually part of the time and allowed to go through the packaging line part of the time. Culls also were sorted out manually. There was an operator for the sizing machine in addition to the manual sorters and sizers. Direct labor required was .159 man-hour per 100 pounds of carrots packaged.

Method 3: Mechanical sizing and manual sorting. --A mechanical sizer at plant D separated the flow of carrots into "jumbos," medium-large, medium-small, and "peewee" sizes. Culls were removed by hand. "Jumbos" and "peewees" were sacked. Medium-large and medium-small carrots were conveyed through separate packaging lines. A full-time operator controlled the sizing machine and other workers sorted manually.

Sizing and sorting required .062 man-hour of direct labor per 100 pounds of carrots packaged.

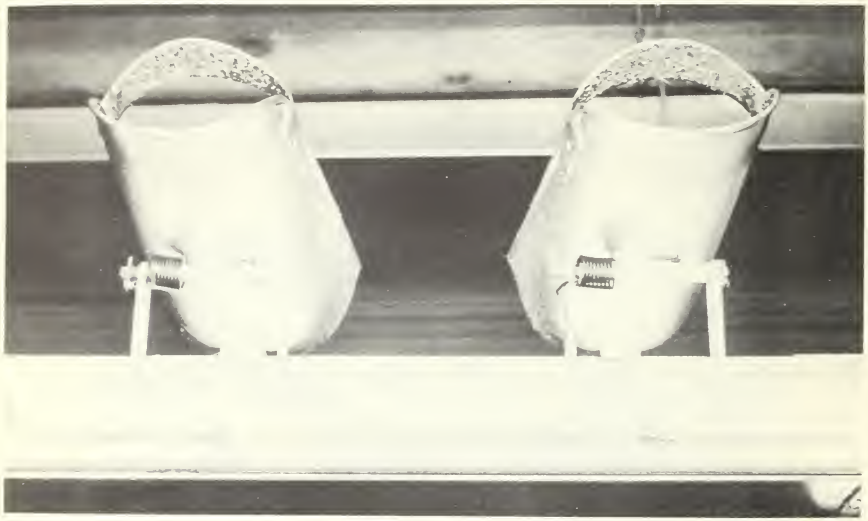
Method 3 with complete mechanical sizing and manual sorting was the most efficient method observed.

Sacking:

Method 1: Manual.--After being sized out of the main flow of carrots the "jumbos" were sacked; the sacks were weighed and adjusted to the 50-pound level, tied and set aside for removal. When there was a market for "peewees" they were also sacked. When there was no market for "peewees," they were removed with the culls. This operation was primarily manual in all plants observed. Direct labor required per 100 pounds of carrots packaged ranged from .010 to .039 and averaged .023 man-hour.

Packaging

Packaging was the most time-consuming and complex operation in the plant. After being sorted and sized, carrots flowed through the packaging area on conveyor belts. Scoop-shaped metal receptacles, called trays, buckets, or scoops, were located alongside the conveyor belts (fig. 9). These oblong scoops had high sides and were open at one end. On this end, which was tapered, the sides met or nearly met at the top, forming a spout. Each scoop was supported on a swivel arrangement which permitted the spout end to be tilted down.



NEG. N-21028

Figure 9.--A closeup view of two carrot scoops, often called buckets or trays. Note springs which return scoops to horizontal position after they have been tilted to dump carrots into bags.

The worker picked a double handful of carrots from the moving belt and placed them in a scoop (fig. 10). A polyethylene bag was fitted over the spout end of the scoop. The scoop was tilted down and the carrots slid into the bag (fig. 11). The bag then was closed or sealed.

NEG. N-21029

Figure 10. --Packer is placing double handful of carrots into scoop.

NEG. N-21030

Figure 11. --Here packer has fitted film bag over mouth of scoop and has tilted scoop to slide carrots into bag.

The packaging process thus included 3 phases, scoop filling, bag filling, and bag closing. These phases were performed either independently or in combination. There were also two subsidiary operations, maintaining the bag supply and check-weighing the filled bags. Table 6 lists the direct man-hour requirements per 100 pounds of carrots packaged for every phase or combination of phases of the packaging operation and its two subsidiary operations.

The scoop filling, the bag filling, the scoop-filling and bag-filling comination, and the bag-filling and bag-closing combinations were all manual. The bag-closing phase, when performed alone, was manual, semiautomatic (pedal-operated stapler) or automatic (taping machine). As observed in the 5 plants, the 3 phases of the main packaging operation were performed by 4 different general combinations or methods:

Method 1: Manual scoop filling, manual bag filling, and automatic bag closing. --In plant D, scoop filling and bag filling were done manually in separate phases by different employees. Bag closing was done automatically by taping machine. The plant required .314 man-hour per 100 pounds of carrots packaged to perform all 3 phases.

Method 2: Manual scoop filling, manual bag filling, and semiautomatic bag closing. --In plant A, scoop filling and bag filling were performed manually in separate phases by different employees. Bag closing was done semiautomatically by pedal-operated staplers. Direct labor for the operation per 100 pounds of carrots packaged was .409 man-hour.

Table 6.--Man-hours of direct labor required for packaging operation, per 100 pounds of carrots packaged, 5 western plants, 1953-54

Operation, phase, and method	Plant					Average
	A	B	C	D	E	
Filling scoops and bags, closing bags:						
1. Worker fills scoop only[1]	.182	.237	.199	.163	--	.198
2. Same worker fills scoops and bags[1]	--	--	--	--	.576	.576
3. Worker fills bags only[1]	.119	--	--	.139	--	.129
4. Same worker fills and closes bags[1]	--	.404	.199	--	--	.302
5. Worker closes bags only	[2] .108	--	--	[3] .012	[1] .147	.089
Total all methods	.409	.641	.398	.314	.724	.497
Bag supply:						
1. Few at a time	--	--	.012	--	.025	.018
2. Adequate supply within reach	-	-	--	0	--	0
Check weighing:						
1. Full-time check weigher	--	.016	--	--	--	.016
2. Occasional spot check.	.001	--	0	0	0	0
Complete packaging operation	.410	.657	.410	.314	.750	.508

[1] Manual operation.
[2] Pedal operated stapler used.
[3] Automatic sealer used.

Method 3: Manual scoop filling, and combination manual bag filling and closing.--In plants B and C, scoop filling was performed manually by one group of workers. A second group of workers filled the bags manually and closed them manually. Man-hours of direct labor for the operation in plant B averaged .641 per 100 pounds of carrots packaged. Direct labor time for this operation at plant C was .398 man-hour per 100 pounds of carrots packaged. The average for the 2 plants using this method was .520 man-hour. The relatively high labor expenditure at plant B was due at least in part to imperfect scoops. After being tilted down to slide the carrots into the film bags, the scoops did not always spring back into a horizontal position, and time was lost in pushing them back. Also, not all the spout ends of the scoops were smooth and correctly shaped. As a result, some bags were torn when the workers attempted to fit them over the spouts.

Method 4: Combined manual scoop and bag filling, and manual bag closing.--At plant E, a single group of workers manually filled the scoops and then manually filled the bags from the scoops. A second group of workers closed the bags manually with paper-covered wire. This operation took .725 man-hour per 100 pounds of carrots packaged. This comparatively high labor requirement at plant E was attributed in part to the fact the scoop fillers also were compelled to do some sizing. The sizing machine separated out only the "Jumbos." "Peewees" were sized out manually when there was no demand for them, and

were allowed to go through the packaging line when there was a demand. Thus, part of the time medium carrots and "peewees" were mixed when they reached the packers. The first girls in the line were obliged to pick up a double handul of carrots which not only weighed approximately 1 pound but which also did not include too many "peewees." After the medium carrots were put into scoops and bagged by the head of the packaging line, the last 5 workers in the line packaged the "peewees" which remained on the belt.

Bag Supply

Method 1: A few at a time.--Plants C and E each employed 2 full-time workers to supply film bags a few at a time as needed by the bag fillers. At plant E, the bags were placed in a small cubicle beside each worker. At plant C, the bag fillers maintained only a few minutes' supply of bags folded over a string tied around the waist. Almost constant calls for replenishments went out to the bag suppliers. Direct labor for supplying bag, per 100 pounds of carrots packaged, was .012 man-hour at plant C and .025 man-hour at plant E. The average was .018 man-hour (table 5).

Method 2: Ample supply within reach.--At plants A, B, and D, supervisors or utility workers occasionally stocked large supplies of bags near the packers. Time for the chore was not sufficient to charge to the operation.

Bag supply in ample quantities as an incidental function of a worker with other duties appeared to be the most efficient method of performing this operation.

Check weighing

Method 1: Full-time check-weigher.--At plant B, one full-time worker spot-checked the weight of the bags of carrots as they were moving from the fillers to the closers. If a bag was found to be underweight, a carrot or two were added. Direct labor for this operation per 100 pounds of carrots packed was .016 man-hour (see table 6).

Method 2: Occasional spot-check.--In plants A, C, D, and E, and occasional bag was check-weighed by a supervisor or by a bag closer. Only in plant A was enough time devoted to this operation to warrant inclusion in the researchers' tabulations. Average time for the 4 plants using the occasional spot-check method, however, was too low to list.

Experienced workers packed the bags slightly overweight with remarkable consistency. Unless the weight tolerance required by the buyer was abnormally rigid, packers as a rule did not consider it worth their while to allot more than a minimum of time to the weighing operation.

CONTAINER ASSEMBLY AND DELIVERY TO PACKAGING LINE

In all plants observed, shipping containers were assembled manually at some distance from the packaging line. Variation in the method of operation was noted only in the way containers were delivered from the assembly area to the filling station.

Method 1: By conveyors only.--Plants A and D were equipped with overhead conveyors which connected the assembly area directly with the container-filling station. One worker at plant A assembled containers and placed them on the conveyor. The containers were removed from the conveyor by the container filler. One full-time worker, assisted by a part-time worker, assembled containers and started them off for the packaging line at plant D. The direct labor to assemble and deliver the containers, per 100 pounds of carrots packaged, was .020 man-hour in plant A and .009 in plant D. The average was .014 man-hour (table 7).

Method 2: By conveyors and manual transfer.--At plant C, the assembly area was rather distant from the container-filling station. Two conveyor belts partially bridged the gap. The conveyors did not meet, so one worker manually transferred the containers from

Table 7.--Man-hours of direct labor required to assemble and transfer shipping containers to packaging line, per 100 pounds of carrots packaged, 5 western plants, 1953-54

Method of operation	Plant					Average
	A	B	C	D	E	
1. Manual assembly and conveyor transfer.....	.020	--	--	.009	--	.014
2. Manual assembly and conveyor-manual transfer.....	--	--	.024	--	--	.024
3. Manual assembly and manual transfer.....	--	.073	--	--	.025	.049

the first belt to the second. Another worker carried the containers from the end of the second belt to the filling station. There also were 2 full-time assemblers. Labor per 100 pounds of carrots packaged, for the assembly and delivery operation by this method, was .024 man-hour.

Method 3: Manual transfer. --The containers were transferred by hand from the assembly area to the packaging line in plants B and E. Direct labor per 100 pounds of carrots packaged was .073 man-hour at plant B and .025 at plant E. The average was .049 man-hour.

Method 1, manual assembly and direct delivery by conveyors, was the most efficient method observed. No labor was required for the delivery between the assembly area and the packaging line.

FILLING SHIPPING CONTAINERS

There was only one method of filling shipping containers--by hand. The 1-pound bags of carrots moved from the bag closers to the container-filling stations by conveyor. The bags were picked by hand from the conveyor and fitted into the shipping containers--48 bags to a wirebound crate (fig. 12) or 24 to a fiberboard box. When full, the containers were pushed along roller conveyors to a nearby closing station. Direct labor for filling ranged from .024 man-hour per 100 pounds of carrots packaged at plants A and D to .049 hour at plant B. The average was .034 man-hour. Efficiency in performance of this operation was influenced for the most part by the regularity of the flow of bagged carrots from the packaging line.

CLOSING, STAMPING, TRANSFERRING, AND LOADING CONTAINERS

After the shipping containers were filled, another operation in three stages was required to get the containers into the freight car or truck:

1. Closing and stamping the containers.
2. Transferring the containers from the closing station to the freight car or truck.
3. Loading the containers into freight car or truck.

In plant A, which had a relatively slow production line with an extremely regular flow of carrots, a single worker with occasional help from a utility man performed all 3 stages of the operation. The other plants required 4 or 5 workers for the complete operation. The name of the shipper and the contents were stamped on the containers by the closers at 4 plants and by a turn-boy at the 5th plant (a "turn-boy" turns or places containers on conveyors so as to send them in the proper direction). Four different methods were employed in the complete operation. Comparative labor requirements for the different methods are shown in table 8.

Neg. N-21031

Figure 12.--Nearing the end of their journey through packing plant, bags of prepackaged carrots here are packed in master container for shipment.

Table 8.--Man-hours of direct labor required to close, stamp, transfer, and load shipping containers, per 100 pounds of carrots packaged, 5 western plants, 1953-54

Method of operation[1]	Plant					Average
	A	B	C	D	E	
1. Manual closing, conveyor transfer.....	--	.072	--	--	--	.072
2. Mechanical closing, conveyor transfer.....	--	--	--	.024	--	.024
3. Manual closing, manual transfer.....	--	--	.030	--	.061	.046
4. Mechanical closing, manual transfer.....	.023	--	--	--	--	.023

[1] Loading in all methods was manual.

Method 1: Manual closing, conveyor transfer and manual loading. --At plant B, 3 workers closed the containers by hand and set them off on a mechanical conveyor. Because the conveyor did not go straight to the loading dock, a turn-boy was employed at the junction with a second conveyor. One man picked the containers from the second conveyor and loaded them manually in the freight car. Man-hours for the operation per 100 pounds of carrots packaged was .072.

Method 2: Mechanical closing, conveyor transfer, and manual loading. --At plant D, one man closed the containers with a lidding machine and set them off on mechanical conveyors along which 2 turn-boys were stationed to keep the containers headed in the right direction. One man loaded manually. Direct labor for the operation, per 100 pounds of carrots packaged, was .024 man-hour.

Method 3: Manual closing, manual transfer, and manual loading. --At plants C and E, 3 men closed the containers manually. One man hand-trucked the containers to the freight car and one man loaded them. Direct labor required for the operation at plant C was .030 man-hour per 100 pounds of carrots packaged, and at plant E, .061 man-hour. The average for this method was .046 man-hour.

Method 4: Mechanical closing, manual transfer, and manual loading. --At plant A, one man closed wirebound crates with a mechanical lidder, hand-trucked them to the freight car, and loaded them. Time for the whole operation by this method was .023 man-hour per 100 pounds of carrots packaged.

Although the man-hour performance for method 4 was fractionally lower than that for method 2, the latter was considered the most efficient. Method 4 held little promise for improvement, whereas method 2 could be made more efficient by elimination of the turn-boys.

SUPERVISION AND MISCELLANEOUS OPERATIONS

Each plant had one or more workers in a supervisory capacity. In addition, 4 plants employed workers whose labor could be assigned to no specific operation, but was charged to the total amount of labor required to package the carrots. Some plants had more supervisory labor than was charged to this classification. In these plants, the supervisors devoted appreciable time to specific operations and left their places on the packaging line only to help out where more urgently needed, to oversee activities elsewhere or to perform other chores. A good example of miscellaneous or utility labor was observed at plant A, where not all the carrots on the conveyor were picked up by the scoop fillers before reaching the end of the packaging line. Carrots remaining on the conveyor spilled over a dead end into crates. This overflow was picked up regularly by a utility man who dumped the carrots back into the washer for another trip through the packaging line. Another example of labor that could be charged to no specific operation was the plant machinery operator who maintained control of the carrot flow through the entire packaging line. Labor expended for supervision and miscellaneous operations ranged from .012 man-hour per 100 pounds of carrots packaged at plant C to .038 man-hour at plant D. Other times listed were .020 man-hour at plant A, .033 man-hour at plant B, and .036 man-hour at plant E. The average was .028 man-hour.

DIFFERENCES IN LABOR REQUIREMENTS

Substantial differences in labor requirements were observed among the various methods of performing the same operations in the carrot packaging process. Direct labor expenditures, per 100 pounds of carrots packaged, for each method of performance of each operation are shown in table 9. Also listed are average direct labor requirements for each operation by all methods.

Potential Savings in Labor

Potential savings of more than 37 percent of the average direct labor requirements were considered possible in the 5 carrot packaging plants surveyed. These savings represented the difference between the average labor requirements of all plants for performance

Table 9.--Comparative efficiency in the use of direct labor to package carrots, by specific operation and method of operation, per 100 pounds of carrots packaged, 5 western plants, 1953-54

Operation and method	Plants using specified method	Average direct labor per 100 lbs. of carrots packaged
	Number	*Man-hours*
Dumping and washing:		
A. Dumping carrots:		
Method 1--Manually from sacks	2	0.019
Method 2--From trailers	2	.015
Method 3--From dump trucks	1	0
B. Controlling washing machine:		
Method 1--By dumper or sorter	1	0
Method 2--By plant machinery operator	2	0
Method 3--By washing machine operator	2	.011
All methods, dumping and washing	5	.018
Sizing, sorting, and sacking:		
A. Sizing and sorting:		
Method 1--Manual sizing and manual sorting	3	.128
Method 2--Manual-mechanical sizing and manual sorting	1	.159
Method 3--Mechanical sizing, manual sorting	1	.062
B. Sacking:		
Only method--Manual	5	.023
All methods, sizing, sorting, and sacking	5	.144
Packaging:		
A. Filling trays, filling bags, and closing bags:		
Method 1--Manual tray filling, manual bag filling, and automatic bag closing	1	.314
Method 2--Manual tray filling, manual bag filling, and semiautomatic bag closing	1	.409
Method 3--Manual tray filling and combined manual bag filling and bag closing	2	.520
Method 4--Combined manual tray filling and bag filling, and manual bag closing	1	.724
B. Bag supply:		
Method 1--Few at a time	2	.018
Method 2--Adequate supply within reach	3	0
C. Check-weighing:		
Method 1--Full-time check weigher	1	.016
Method 2--Occasional check-weighing	4	0
All methods, packaging	5	.508

Table 9.--Comparative efficiency in the use of direct labor to package carrots, by specific operation and method of operation, per 100 pounds of carrots packaged, 5 western plants, 1953-54--Continued

Operation and method	Plants using specific method	Average direct labor per 100 lbs. of carrots packaged
Shipping container assembly and delivery to packaging line (all plants assembled manually and only variation was in method of delivery)	*Number*	*Man-hours*
Method 1--By conveyors only	2	.014
Method 2--By conveyor and manual transfer	1	.024
Method 3--By manual delivery	2	.049
All methods, container assembly and delivery	5	.030
Filling, shipping containers:		
Only method--manual filling	5	.034
Only method, container filling	5	.034
Closing, stamping, transferring, and loading containers (all stamping and loading manual)		
Method 1--Manual closing, conveyor transfer	1	.072
Method 2--Mechanical closing, conveyor transfer	1	.024
Method 3--Manual closing, manual transfer	2	.046
Method 4--Mechanical closing, manual transfer	1	.023
All methods, closing, transferring, loading containers	5	.041
Supervision and miscellaneous	5	.028
Total, all operations		.803

of all operations and the labor requirements of those plants employing the most efficient methods. These different labor requirements and the possible savings for each operation are shown in tables 9 and 10.

The survey indicated that the packaging of carrots could be accomplished more efficiently by general adoption of the following methods and adjustment of facilities:

1. Transportation of carrots from the fields in hydraulic lift trucks in bulk rather than in bags.

2. Improvement in facilities at the plant for receiving the carrots.

3. Location of production-line machine controls so that a single operator could regulate more than one operation.

4. Improvement of conveyor systems to eliminate dead ends and unnecessary manual transfers.

5. Use of mechanical sizers to separate out all sizes--not just the large ones or the small ones.

6. Use of properly designed scoops or buckets which facilitate slipping the carrots into film bags.

Table 10.--Comparative efficiency of average performance by all methods and performance by most efficient method, by man-hours for each packing operation, per 100 pounds of carrots packaged, 5 western plants, 1953-54

Most efficient method of performing operation	Direct labor required to perform operation by most efficient method	Average labor required to perform operation by all methods in 5 plants	Possible saving of labor by use of most efficient method
	Man-hours	*Man-hours*	*Man-hours*
Dumping from lift trucks and control of washing by plant machinery operator.....	0	.018	.018
Mechanical sizing, manual sorting, and manual sacking of "Jumbos" and "peewees".....	.085	.144	.059
Manual scoop and bag filling, and automatic bag closing with occasional check-weighing.....	.314	.507	.193
Manual assembly of shipping containers and delivery by conveyor to packaging line.....	.014	.030	.016
Manual filling of containers.....	.034	.034	0
Machine closing of containers, conveyor transfer to shipping dock, and manual loading.....	.024	.042	.018
Supervision and miscellaneous....	.028	.028	0
Total, all operations.....	.499	.803	.304

7. Use of fully automatic machines to close the bags.

8. Use of simiautomatic lidding machines to close the shipping containers in lieu of manual closing.

Adoption of the changes and adjustments listed would result in savings of direct labor. Assuming that the labor cost for prepackaging carrots was around $1.25 per 100 one-pound bags in 1954, a 37-percent labor reduction would reflect a potential annual labor saving to the commercial carrot industry of approximately 2 million dollars. Many packaging plants already have changed over to incorporate some or all of these findings in their operations. The cost of the changes and adjustments, however, were not studied. Whether alterations should be made or new equipment should be purchased by a particular plant could be determined only by an analysis of the individual situation.

TRADE PREFERENCE FOR PREPACKAGED VERSUS BUNCHED CARROTS, 1954

To determine the trade preference between prepackaged and bunched carrots, interviews were obtained in 1954 with officials of 26 grocery chains and 26 fresh produce service wholesalers. The chains had a reported total of 14,230 retail outlets and the wholesalers said they serviced more than 12,000 stores. The chains included the 10 largest in number of stores.

The interviews revealed that 38 percent of the grocery chains and 42 percent of the produce wholesalers sold all their carrots in prepackaged units; 58 percent of the chains and 85 percent of the wholesalers sold 90 percent or more of their carrots prepackaged; and 96 percent of the chains and all of the wholesalers sold more than half of their carrots prepackaged.

Carrots were sold as follows:

	No. of grocery chains	No. of service wholesalers
Prepackaged only	10	11
90-99% prepackaged	5	11
50-89%	9	4
None prepackaged	2	0
	26	26
Bunched only	2	0
25-50% bunched, snap or clip top	7	1
Less than 25% do.	7	14
No bunched, snap or clip top	10	11
	26	26

Because they had no first-hand experience with prepackaged carrots, the 2 chains selling bunched carrots only were dropped from subsequent tabulations. Of the remaining 24 chains, all but 1 sold carrots in 1-pound polyethylene bags, only. All but 1 of the service wholesalers also sold carrots in 1-pound bags. One chain and 1 wholesaler sold prepackaged carrots in 1-pound bags and also in 1-1/2 pound bags. Four chainstore officials and 1 wholesaler said they would prefer bags larger than the 1-pound size, but the others opposed a change. The majority feeling was that consumers had become accustomed to the 1-pound packages and that a change would cause confusion.

Only 2 of the 50 interviewed said they considered tearing or breakage of the film a problem. Those 2 said that in the past they had received some torn bags, but had remedied the situation by changing their suppliers. Paper-covered wire "twist 'ems," used to tie film bags, vinyl-coated "twist 'ems," and heat sealing, in that order, were the most popular methods of closure. Paper-covered "twist 'ems" were far in the lead, but even these were criticized for a reported tendency of the paper to pull loose from the wire when wet. A pressure-sensitive tape, just coming on the market when the interviews were being conducted, was well liked by the few who had had experience with it.

The chain officials and wholesalers agreed that, because carrots have a distinctive natural color, the color of the bags and the printing ink used on them should enhance rather than detract from the color of the carrots. Most of those interviewed favored a clear film, designed to show the carrots in their true color. For the printing on the bag, medium shades of green, blue, or red were favored.

Individual comments indicated a need for the shipper to bear in mind that the prepackaged units should appeal to a woman's taste, and should not be of the design and color of the standard crate labels, which are intended to catch the eye of men in the wholesale trade. Almost 9 out of 10 of the chain officials and wholesalers favored film bags with 85 percent or more visibility. If the commodity is of good quality, which it should be, it should not be concealed, they contended. Slightly more than half favored printing recipes or other information on the bags if there was no interference with visibility, and most favored having a small white spot on which the price could be stamped.

Carrots should be placed with the roots all pointing in one direction in the bag most dealers said, and should be uniform size. The agreement on uniform size was almost unanimous, but several argued in favor of placing the carrots both ways in the bag to obtain a more snug fit. Two-thirds wanted the consumer bags packed 48 to the master shipping container, and most of the remainder wanted 24 to the master container. Two-thirds were receiving their carrots in wirebound crates and preferred this type of master container. The others were receiving and preferred fiberboard containers. Most did not consider container damage an important problem.

Approximately 60 percent indicated they would like to have carrots prepackaged at point of production, 6 percent preferred packaging at the terminal level, and the rest didn't care.

All wholesalers and all but one chain official said that the average quality of prepackaged carrots reaching the market was satisfactory. Similarly, all but one indicated that spoilage of prepackaged carrots was no problem. The exception declared: "Average quality is not good enough at any time. Let's pack and sell the best."

Opinion was evenly divided on whether retail customers recognize any difference between fresh and cold-storage carrots. Half said they could and half said they could not.

SALABILITY OF PREPACKAGED VERSUS BUNCHED CARROTS, 1954

The comparative salability of western-grown carrots in bunches with their tops left on and carrots prepackaged in film bags was evaluated in 6 cities in the summer and fall of 1954.

The observations were made in 3 medium to large national or regional chain outlets and in 3 medium to large independent stores or local chain outlets in each of 4 cities--metropolitan New York, Boston, Grand Rapids, and Detroit. Also, 8 stores were utilized in Chicago, and 9 stores in Los Angels. Tests in most of the stores were conducted for 4 consecutive weeks. The bunched carrots and the prepackaged carrots were given equally prominent displays, often side by side (fig. 13).

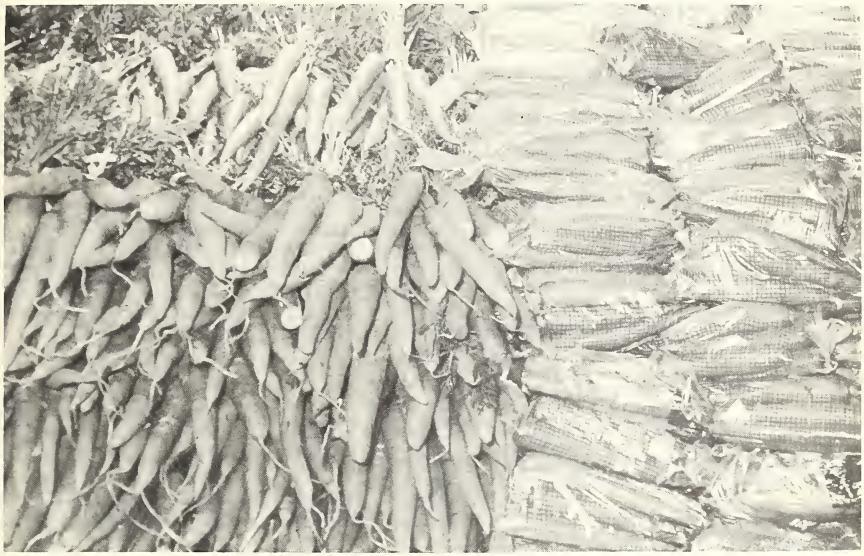


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Figure 13.--Here bunched and prepackaged carrots are on sale side by side in one of 41 test stores in 6 cities in 1954. This was not a particularly attractive arrangement of the bunched carrots. Twisting root ends and broken roots detract from their appearance. In the best displays, the roots did not point into the aisle but were laid parallel to it in two directions with roots on right and left and a mound of green tops between.

An approximate 20 percent price premium was to have been charged for the prepackaged carrots, but after the early days of the tests, most store managers switched to the competitive or prevailing prices in the locality. Prices varied, but most often bunched carrots sold for 12 or 12-1/2 cents a bunch compared with 14-1/2 or 15 cents a bag for prepackaged carrots. As a rule, bunched carrots were priced lower than prepackaged carrots. However, one Detroit store group priced bunched carrots 2 cents higher throughout the test period. The edible roots in a bunch of carrots weighed approximately 1 pound. The topped carrots were packaged in bags stamped "1 pound" but they actually averaged 1-1/4 pounds.

Given an equal opportunity to buy either prepackaged or bunched carrots, store patrons bought 102,791 bunches and 65,433 film bags of carrots. Bunched carrots outsold bagged carrots in the tests in 10 of the 12 store groupings.

Variation Among Cities

It should be noted, however, that the preference for the bunched carrots was most evident in Los Angeles, which was the closest to the sources of supply of all the cities surveyed (table 11). Because of this proximity, the bunched carrots came to market in Los Angeles looking fresher than was possible in the more distant markets of the Middle West and East. Bunched carrot sales in Los Angeles were 76.4 percent of all carrot sales. Including Los Angeles, sales of bunched carrots, in the 6 test cities, were 61.1 percent of all sales. Excluding Los Angeles, sales of bunched carrots were 54.3 percent of all sales.

There also was considerable variation among the other cities surveyed. In New York, Detroit, and Grand Rapids, overall sales of bunched carrots were appreciably higher than over-all sales of prepackaged carrots. In Boston, however, overall sales of prepackaged carrots were greater--58.6 percent of total sales. In Chicago, sales of prepackaged and bunched carrots were almost equally divided.

Reaction of Retailers to Bunched and Prepackaged Carrots

Whether they normally sold prepackaged carrots, bunched carrots, or both, and regardless of what their customers preferred, retail store operators and fresh produce managers almost without exception were critical of bunched carrots and strongly favored handling prepackaged carrots. The following reasons were given:

1. The tops of bunched carrots often have to be removed by a produce clerk, or at the check stand.

2. The "checkout" of bunched and bulk commodities is very slow.

3. The stores must provide for the disposal of the removed tops.

4. When the customers remove the tops, they toss the greens on the stand, on the floor, or on top of other products.

5. The produce workers do not like to handle the ice and moisture which come with the bunched carrots.

6. Moisture and removed tops constitute a serious safety hazard to traffic in the stores.

7. Wilted, yellow, or "burned" tops actually cause the customers to refuse the product, although the edible roots may be perfectly satisfactory.

8. Retail clerks claim that bunched carrots require constant trimming of the tops, rearrangement of the display, and watering of the carrots on the rack.

Table 11.--Comparative sales and prices of western-grown carrots in prepackaged bags and in bunches, 6 cities, 1954

Place	Carrots sold		Retail price	
	Prepackaged	Bunched	Prepackaged	Bunched
	Bags	*Bunches*	*Per bag*	*Per bunch*
Metropolitan New York				
Independent stores (3)	3,048	6,156	.15-.21	.12-.17
National chain stores (3)	6,419	7,545	.15-.19	.12-.195
Total: New York	9,467	13,701	.15-.21	.12-.195
Percent	40.9	59.1	-	-
Boston				
Independent stores (3)	3,411	5,774	.145-.19	.095-.15
National chain stores (3)	16,353	8,213	.145	.115-.145
Total: Boston	19,764	13,987	.145-.19	.095-.15
Percent	58.6	41.4	-	-
Grand Rapids, Mich.				
Independent chain stores (3)	6,354	8,811	.125-.145	.145
National chain stores (3)	2,412	4,509	.170	.125-.145
Total: Grand Rapids	8,766	13,320	.125-.170	.125-.145
Percent	39.7	60.3	-	-
Detroit, Mich.				
Local chain stores (3)	7,028	13,354	.145-.175	.145
National chain stores (3)	2,755	3,473	.175	.195
Total: Detroit	9,783	16,827	.145-.175	.145-.195
Percent	36.8	63.2	-	-
Chicago, Ill.				
Local chain stores (3)	2,481	2,488	.125-.165	.125-.195
National chain stores (3)	1,755	1,923	.125-.145	.125
Additional 2 stores	1,284	1,144	.10-.145	.125-.135
Total: Chicago	5,520	5,585	.10-.165	.125-.195
Percent	49.7	50.3	-	-
Los Angeles, Calif.				
Local chain stores (9)	12,133	39,371	.045-.125	.045-.095
Percent	23.6	76.4	-	-
Grand total (all cities)	65,433	102,791	.045-.21	.045-.195
Percent	38.9	61.1	-	-

9. Bunched carrots are not a unitized product and they require a bag, which must be furnished by the store.

10. Loss of the product by decay, wilting, breakage, and pilfering causes a direct monetary loss to the stores.

11. Weight of the large shipping containers used in handling bunched carrots is too much for the modern stores, since they now employ many young men and women in their produce departments.

12. Higher transportation costs result from the shipment of unnecessary tops and other discarded parts of the bunched carrots.

13. Dirt, moisture, and color (from the green tops and from the roots) get on the customers.

14. Breakage of the roots and the removal of carrots from the bunches result in losses.

COST OF RETAILING PREPACKAGED AND BUNCHED CARROTS, 1954[9]

During the summer of 1954, a USDA research specialist spent 1 week, full-time, in 2 supermarkets in each of 4 metropolitan areas to determine the comparative cost of handling prepackaged and bunched carrots. The stores were located in the New York, Boston, Grand Rapids, and Detroit areas. All were self-service chain stores--4 national, 2 regional, and 2 local.

The tests revealed that:

1. The cost of handling prepackaged carrots at retail was very slight, amounting to approximately 2 cents of every sales dollar, as compared to more than 14 cents of every dollar of sales of bunched carrots.

2. Waste and spoilage losses of prepackaged carrots were much less than for bunched carrots--less than 1 percent as compared with more than 8 percent--principally because there was less breakage of the prepackaged roots in consumer handling and there was no loss of appearance and salability due to deterioration of the tops.

3. Bunched carrots required considerably more attention--more than 5 cents of every dollar of sales was earmarked for the cost of labor, compared to about 1 cent for prepackaged carrots.

During the tests, only western carrots (California or Arizona) were available for sale in the stores. Receipts of bunched carrots were packed 72 bunches per crate, while prepackaged carrots arrived in 2-dozen fiberboard cartons or in wirebound crates containing 4 dozen packages. With one exception, there was always a sufficient quantity of both types of carrots available for sale in all stores and, for the most part, the space devoted to display of each type was approximately equal.

The USDA research specialist kept detailed records on inventories, receipts, prices, packaging materials and labor costs, and waste and spoilage losses. A stopwatch was used to obtain data for conversion of time into the relative labor costs for each method of merchandising carrots.

The comparative amounts of waste and spoilage losses, and packaging materials and labor costs, and their effect on retail margins are shown in table 12.

The savings in waste and spoilage losses that resulted from retail merchandising of prepackaged carrots are readily apparent. The retail value of carrots lost through markdowns and waste and spoilage averaged 8.1 percent of realized sales when sold in bunches. The loss was less than 1 percent--0.6 percent--in the case of prepackaged carrots. With both bunched and prepackaged carrots on sale at the same time, spoilage losses for both probably were higher than they would have been if only one type had been on sale. With only one type of carrots on sale, a more rapid turnover might be expected.

The cost connected with packaging materials was relatively insignificant in the retailing of carrots, averaging less than 1 percent of the retail sales value of bunched carrots and a negligible sum for prepackaged carrots as revealed in the 8-store test.

[9] Prepared by Russell L. Hawes, currently in Vegetable Branch, Fruit and Vegetable Division, AMS.

Table 12.--Comparison of retail margins and costs of handling prepackaged and bunched carrots in 8 self-service food stores in 4 metropolitan areas, June-August 1954[1]

Item	Unit	Prepackaged	Bunched
Quantity handled (packages or bunches)	Number	3,759	4,370
Average retail price (per package or bunch)[2]	Cents	15.4	13.7
Retail extension value[3]	Dollars	578.62	600.42
Quantity sold (packages or bunches)	Number	3,739	4,069
Realized sales[4]	Dollars	575.01	555.23
Average cost (per package or bunch)	Cents	10.424	7.792
Cost of quantity handled	Dollars	391.85	340.49
Average markup[5]	Percent	47.7	76.3
Original gross margin[6]	Dollars	186.77	259.93
Gross margin as percentage of sales	Percent	32.5	46.8
Waste and spoilage loss	Dollars	3.61	45.19
	Percent	0.6	8.1
Packaging materials cost	Dollars	0.20	4.91
	Percent	-	0.9
Labor cost	Dollars	7.36	28.60
	Percent	1.3	5.2
Total waste, spoilage, container, and labor cost)	Dollars	11.17	78.70
	Percent	1.9	14.2
Realized gross margin[7]	Dollars	175.60	181.23
	Percent[8]	30.5	32.6

[1] Enumerator spent one full week in each of the 8 stores. There were 2 cooperating stores in each metropolitan area: New York, Boston, Grand Rapids, and Detroit.
[2] Prepackaged carrots priced above bunched carrots in 6 of 8 stores.
[3] Retail extension value computed by subtracting closing inventory from sum of opening inventory and receipts.
[4] Realized sales equal retail extension value less waste and spoilage loss.
[5] Retail extension value less cost of quantity handled divided by cost.
[6] Retail extension value less cost of quantity handled.
[7] Original gross margin less waste and spoilage loss, container, and labor costs.
[8] Realized gross margin divided by realized sales.

The 8-store test showed that, for every dollar spent by consumers for bunched carrots, the retailer had to disburse 5.2 cents for labor. On the other hand, the labor costs chargeable to prepackaged carrots averaged only 1.3 percent of the value of retail sales.

The total direct costs of retailing carrots--that is, the costs of waste and spoilage, packaging materials, and labor--amounted to 14.2 percent of sales for bunched carrots, compared with approximately 1.9 percent for prepackaged carrots. Although the realized gross margin figures in this 8-store test appear, at first glance, to favor the merchandising of bunched carrots, it should be noted that the average markup on bunched carrots was much greater--76.3 percent as compared to 47.7 percent--than the markup on prepackaged carrots.

EVALUATION OF CHEAPER MASTER CONTAINERS, 1956 [10]

The widespread adoption of carrot prepackaging was accompanied by experimental use of new master containers. In Texas in the 1956 winter season, the wirebound crate was conventionally employed to ship 48 one-pound bags of prepackaged carrots, but there also was great interest in multiwall paper bags for 48 consumer packages, and polyethylene bags for 24 packages.

USDA research economists made a series of comparative evaluation tests which indicated that, because of lower costs, from $100 to $145 per carload could be saved by using paper or polyethylene bags as master containers under suitable conditions.

The more expensive wire bound crates were the sturdiest, stacked well, could be efficiently top-iced, and were favored in markets where there was considerable rehandling from receivers to wholesalers, jobbers, and retailers.

The less expensive paper bags were popular with some receivers who distributed the carrots directly to their own retail stores. Paper bags often were torn and scuffed when top-iced in transit, but they protected their contents adequately when the carrots were precooled and shipped only with bunker ice.

Polyethylene master bags held up quite well under top icing. There was some minor puncturing, but the holes were small and the contents did not spill out. In one shipment, some bags came apart at the bottom seam, apparently as a result of improper sealing. A number of receivers said they liked to handle the 24-unit polyethylene bags and their customers favored this smaller master container.

By the end of 1955, at least four new fiberboard cartons of different sizes and types had been introduced by the California carrot industry. These were not included in the present study, but tests of their performance with respect to their refrigeration in transit have been reported.[11]

After the 1956 study, interest in multiwall paper bags increased greatly. One estimate indicated that approximately half of the prepackaged carrots shipped from Texas in the winter of 1957 were in paper bags.

PRESENT STATUS OF CARROT PREPACKAGING

More than 85 percent of the carrots grown commercially for the fresh market were prepackaged in 1956, it is estimated. In many sections of the country, retail offerings of bunched carrots are becoming increasingly rare. Once it caught on, the trend to prepackaging was swift and sure.

In 1951, the estimated volume of carrots prepackaged was a scant 1 percent of the total consumed fresh. Most fresh carrots were sold bunched. Some with discolored or frost-killed tops were sold in bulk without tops. In 1952, prepackaged carrots were 5 percent of the volume; they jumped to 45 percent in 1953, to 75 percent in 1954, to 80 percent in 1955, and, if the trend has continued as many observers believe, to more than 85 percent in 1956.

When they learned that prepackaged carrots reduced their losses and handling costs and also provided added convenience for their customers, retail store operators exerted the strongest influence in bringing about the shift to prepackaging. When the retailers began ordering prepackaged carrots in heavy volume, shippers were obliged to prepackage.

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[10] Hale, Philip W., and Stokes, Donald R., Shipping Containers for Prepackaged Carrots, Agricultural Marketing, August-September 1956.

[11] Barger, W. R., and Radspinner, W. A., Transit Refrigeration Studies with California Prepackaged Carrots, mimeographed progress report, AMS-97, USDA, April 1956.

Most carrots are prepackaged today at point of production. Although unsuccessful in the initial years of experimental work, prepackaging carrots at the wholesale level also is fairly common today. In the early trials, bunched carrots with tops intact were shipped to the wholesale warehouse. At present, bulk carrots are shipped topped. The prepackager thus avoids both the higher transportation and refrigeration charge for the tops and the cost of labor to remove the tops.

The change from marketing bunched carrots to marketing topped carrots in prepackaged consumer units was accompanied by a marked regional shift in the country's winter carrot production areas. Between 1951, when the changeover was just beginning, and 1956, Texas sharply increased its production of carrots. The Arizona and California winter production declined. The overall winter total in the 3 States was up slightly.

The winter season is the major carrot season in Texas. Northwest Texas, however, recently started marketing some carrots in the early fall. California has three seasons, and it maintained its position as the leading year-around producer by increasing its early summer and late fall crops. In Arizona, however, both the winter and spring production fell off. In the 3-State area, the year-around carrot production was moderately higher in 1956 than in 1951.

Elimination of carrot tops and the ice required to keep them fresh permitted increased efficiency in the use of transportation. In 1951, 23,846 rail carloads and truck carlot equivalents of carrots were shipped out of the 3 States. In 1956, a slightly larger volume of edible carrot roots was transported to market in 21,036 rail carloads and truck carlot equivalents. Without tops, there were more carrots in each car and truck.

A carload of bunched carrots contains about 25,200 pounds of edible roots. A carload of either prepackaged or bulk topped carrots contains about 30,000 pounds of roots. In 1951, approximately 80 percent of California, Texas, and Arizona carrot shipments were bunched and 20 percent topped. In the following years, topped carrot shipments gained steadily, while bunched carrot shipments declined. By 1956, the 1951 situation was reversed; topped carrot shipments accounted for 90 percent of the total and bunched carrots only 10 percent. Thus most carrot carlot shipments in 1951 were 25,200 pounds each, while in 1956 most shipments were of 30,000 pounds each.

Based on the number of carlots and the proportions of bunched versus topped carrots listed above, it is estimated that 614 million pounds of edible roots were shipped out of the 3 States in 1951 and 621 million pounds were shipped out in 1956. California, Texas, and Arizona are all growing rapidly in population, and when the quantity of carrots consumed within their own borders is considered, the increase in total carrot shipments is much more impressive. It is apparent that much larger quantities of the local production are being consumed at home. In California, for example, truck unloads of carrots in the three major city markets alone increased from 3,696 carlot equivalents in 1951 to 6,172 carlot equivalents in 1956.

The amount of carrots eaten by the average American apparently has changed little in recent years. The USDA estimated the per capita consumption of fresh carrots in 1956 was 7.7 pounds, almost the same as in 1951.

RELATED PUBLICATIONS

This is one of a series of reports issued by the U. S. Department of Agriculture on the economic phases of marketing prepackaged fresh fruits and vegetables. Other selected reports issued by the Department or in cooperation with other agencies are:

Retailing Prepackaged Fresh Produce by Self-Service Food Stores, Marketing and Transportation Situation, April-May 1948, by Donald R. Stokes

Marketing Florida Prepackaged Sweet Corn, April 1949, by A. H. Spurlock, Florida Agricultural Experiment Station, and Donald R. Stokes, USDA

Prepackaging Apples at Point of Production, Agriculture Information Bulletin No. 29, January 1951, by Earl W. Carlsen, Washington State Apple Advertising Commission, and Donald R. Stokes, USDA

Prepackaging Spinach and Kale, Bulletin A-63, University of Maryland, College Park, Md., August 1951, by Fletcher Pope, Jr., and George Max Beal, Maryland Agricultural Experiment Station, and Robert L. Harrison, USDA

Variation in Quantity of Fibreboard Used in Master Containers for Prepackaged Tomatoes, August 1952, by Beulah C. Robertson and Wm. A. Aronow

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